

# Select the Right Portable Generator after a Disaster

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## General

Power outages can leave a home without power for lighting, cooking, refrigeration and pumping water. Portable generators can be bought to provide substitute power. However, the generator must be properly sized to start the appliances and equipment you want to run.

## What To Do (For 120-volt, plug-in appliances)

First, find the wattage of the appliance(s) you want to run by checking the nameplate. Motor-driven appliances may be listed in horsepower which must be converted to watts. Motors require four times as much power to start as they do to run. If the running wattage of a motor is 400, then the starting wattage will be 1,600. The following table gives some starting and running wattage for electrical motors:

**Table 1**  
**Watts Required**

Motor hp	To start	To run
1/6	1,000	215
1/4	1,500	300
1/3	2,000	400
1/2	2,300	575
1	4,000	1,000
7.5	18,000	4,500
10	36,000	9,000

Now determine how many appliances you want to run at the same time and add or total the wattage. The size of the generator you use must be such that it will start and run the necessary appliances. If you get a generator that is too small to run refrigerators and freezers, they will try to start, but the voltage will drop and their motors will overheat and burn out. If you cannot find the wattage, an estimate can be made from the following table:

## Table 2

### Typical Equipment Wattages

<b>Essential home equipment</b>	<b>Typical wattage</b>
Refrigerator	400 – 800
Freezer	600 – 1,000
Furnace blower	400 – 600
<b>Optional home equipment</b>	<b>Typical wattage</b>
Electric skillet	1,150 – 1,500
Electric stove	3,000 – 4,000
Washing machine	400
Water pump	800 – 2,500
Water heater	1,000 – 5,000
Electric fan	75 – 300
Central air conditioner	2,000 – 5,000
<b>Farm equipment</b>	<b>Typical wattage</b>
Ventilator fans	300 – 800
Silo unloader	2,000 – 7,500
Feed mixer	800 – 1,500
Feed conveyer	800 – 5,000
Bulk milk cooler	1,500 – 12,000
Electric fence	7 - 10

For example, if you want a generator to run a refrigerator and a freezer, the wattage (table 2) of the refrigerator would be 800 and the freezer would be 1,000. To select the correct size generator, you decide if both refrigerator and freezer are to start at the same time. If so, you would need  $(1,800 \times 4)$  7,200 watts. You would select the nearest larger wattage generator. If you can be certain both appliances will not start at the same time, you would only need 4,800 watts (to run the refrigerator while starting the freezer).

## Installation

Install wiring and equipment to meet National Electrical Code requirements, local regulations and the requirements of the power supplier. Single phase standby generators are connected to the electrical line by a double-pole, double throw transfer switch. This prevents accidentally feeding power back into the utility lines where it can injure neighbors or utility workers servicing the lines. This type switch also protects the generator from damage when power is restored.

Put the switch in a water-tight box and properly ground it, the central meter pole is a common location. Install the switch between the watthour meter and the service disconnect (main fuse box). Note that the white (neutral) conductor is usually not switched, but some power suppliers require it be switched also. When the handle is up, the utility black and red conductors are connected to the load black and red conductors, respectively. In the down position, the load conductors are disconnected from the utility conductors and connected to the black and red conductors from the generators.

Based on information developed by Clemson Cooperative Extension following Hurricane Hugo. Revised for Virginia audiences by Virginia Cooperative Extension.

# Consumer Product Safety Commission Safety Alert

## Portable Generator Hazards

Portable generators are useful when temporary or remote electric power is needed, but they also can be hazardous. The primary hazards to avoid when using a generator are carbon monoxide (CO) poisoning from the toxic engine exhaust, electric shock or electrocution, and fire.

Every year, people die in incidents related to portable generator use. Most of the incidents associated with portable generators reported to CPSC involve CO poisoning from generators used indoors or in partially-enclosed spaces.

### Carbon Monoxide Hazards

**NEVER** use a generator in enclosed or partially-enclosed spaces. Generators can produce high levels of CO very quickly. When you use a portable generator, remember that you cannot smell or see CO. Even if you can't smell exhaust fumes, you may still be exposed to CO.

If you start to feel sick, dizzy, or weak while using a generator, get to fresh air **RIGHT AWAY. DO NOT DELAY.** The CO from generators can rapidly lead to full incapacitation and death.

If you experience serious symptoms, get medical attention immediately. Inform medical staff that CO poisoning is suspected. If you experienced symptoms while indoors, have someone call the fire department to determine when it is safe to re-enter the building.

Follow these safety tips to protect against CO poisoning:

- **NEVER** use a generator indoors, including in homes, garages, basements, crawl spaces, and other enclosed or partially-enclosed areas, even with ventilation. Opening doors and windows or using fans will not prevent CO build-up in the home.
- Follow the instructions that come with your generator. Locate the unit outdoors and away from doors, windows, and vents that could allow CO to come indoors.
- Install battery-operated CO alarms or plug-in CO alarms with battery back-up in your home, according to the manufacturer's installation instructions. The CO alarms should be certified to the requirements of the latest safety standards for CO alarms (UL 2034, IAS 6-96, or CSA 6.19.01).
- Test your CO alarms frequently and replace dead batteries.

### Electrical Hazards

Follow these tips to protect against shock and electrocution:

- Keep the generator dry and do not use in rain or wet conditions. To protect from moisture, operate it on a dry surface under an

open, canopy-like structure. Dry your hands if wet before touching the generator.

- Plug appliances directly into the generator. Or, use a heavy duty, outdoor-rated extension cord that is rated (in watts or amps) at least equal to the sum of the connected appliance loads. Check that the entire cord is free of cuts or tears and that the plug has all three prongs, especially a grounding pin.
- **NEVER** try to power the house wiring by plugging the generator into a wall outlet, a practice known as “backfeeding.” This is an extremely dangerous practice that presents an electrocution risk to utility workers and neighbors served by the same utility transformer. It also bypasses some of the built-in household circuit protection devices.
- If you must connect the generator to the house wiring to power appliances, have a qualified electrician install the appropriate equipment in accordance with local electrical codes. Or, check with your utility company to see if it can install an appropriate power transfer switch.
- For power outages, permanently installed stationary generators are better suited for providing backup power to the home. Even a properly connected portable generator can become overloaded. This may result in overheating or stressing the generator components, possibly leading to a generator failure.

### **Fire Hazards**

Follow these tips to prevent fires:

- Never store fuel for your generator in the home. Gasoline, propane, kerosene, and other flammable liquids should be stored outside of living areas in properly-labeled, non-glass safety containers. Do not store them near a fuel-burning appliance, such as a natural gas water heater in a garage. If the fuel is spilled or the container is not sealed properly, invisible vapors from the fuel can travel along the ground and can be ignited by the appliance’s pilot light or by arcs from electric switches in the appliance.
- Before refueling the generator, turn it off and let it cool down. Gasoline spilled on hot engine parts could ignite.

## Portable Generator Safety

Residential use of portable generators is growing rapidly. As the average age of homeowners goes up, their tolerance for the more frequent and longer power outages that we are likely to experience is going down. With this has come complacency about portable generators. There is less concern with safety, installation, and operation of emergency power sources and more with creature comforts that generators give.

Many people think of generators as just another home appliance. The refrigerator is safe, so is the TV. The new generator must be also. It has a UL (Underwriters Lab.) sticker. Generators are different animals.

First, a gasoline engine usually drives a portable emergency power source. When gasoline engines are running they give off carbon-monoxide, a deadly gas. Air-cooled engines run very hot. A generator can easily start a fire with its exhaust. This is basic common sense; everyone knows that running an engine in an enclosed area is hazardous to your life and property. Here is where I have to tell you that you must abide by all federal, state and local regulations about using generators. If you are not a licensed electrician get one and all permits necessary before even thinking about hooking a generator to your home wiring. Have you read the Owners manual? If not, do it now. Follow all the manufacturer recommendations.

**How about grounding?** Don't worry you say? Oh, you bought an expensive generator that is equipped with a GFI (Ground Fault Interrupter). Well did you know that a GFI might not function at all if the generator is not properly grounded? Recently we had a customer bring in a new generator for service. He should have bought a lotto ticket that day. His generator had an internal short circuit that made the handles on the unit electrically charged (hot as we say). Had he touch the wrong two things, at the same time, it could have killed him.

**Do not use that generator until its been safely ground.**

Grounding is simple, refer to that owners manual. It would most often tell you to attach a #8 copper wire to: a metal water pipe that travels at least 10 feet into the ground, hook to a building ground, or drive a metal rod 8 feet into the earth, etc. Make sure you use a rod that is permitted for grounding. There are minimum sizes and material that will give you the proper grounding.

While we are on the subject of grounding do not overlook the appliance or tools grounding requirements when hooking it to a generator. Always use 3 prone extension cords in good condition and correct size. Using the wrong cords may damage the generator or its load.

Speaking of loads, let's cover a little about Transfer Switches". A transfer switch has a couple of very important functions. Transfer switches must be used to connect emergency power sources (the generator) to a home. The transfer switch must keep the generators power from going out onto the utility lines at all cost. More than one lineman has been injured while working on what should have been a dead wire but was hot because of a residential generator that he didn't know was there. By the way, if you do hookup a generator to your home or business you must notify the electric company that you have a generator. Transfer switches are simple in design but carry a great burden when an emergency hits. The switch must bring both the utility and generators power into the same circuit box but only allow one or the other to be connected to the load (refrigerator). Transfer switches must interrupt the incoming power, utility or generator, before connecting

it to the load. That's obvious. It must control arcing. Arcing must stop before the power switch is completed or the generator will most likely be destroyed. Fires and personal injury may also occur. One might ask, are all transfer switches the same? The answer is no. Are you safe if the transfer switch is UL listed? Not always. Look for switches that are listed UL1800. The UL label must specifically state, "Automatic Transfer Switch", "Transfer and Bypass-Isolation Switch", or "Non-Automatic Transfer Switch". If your switch is not labeled this way it has not complied with UL1800 but rather a far-less-rigorous UL standard. Switches that are not UL1800 may not perform adequately when you need them the most. The only way you will find out is when the switch is called upon in a crisis situation. Like a 5000Amp short circuit, when a tree branch falls across the utility lines. That is like testing a new fire hose on its first 4-alarm fire. There is no such thing as too much safety when you are around electricity. Here's hoping the lights stay on.

## Generators

The following information, developed by the Red Cross with technical advice from the Centers for Disease Control and Prevention, the National Fire Protection Association (publisher of the *National Electric Code*®) and the U. S. Consumer Product Safety Commission, is provided to address questions about using a generator when disaster strikes.

### **Purchasing a Generator**

If you choose to buy a generator, make sure you get one that is rated for the amount of power that you think you will need. Look at the labels on lighting, appliances, and equipment you plan to connect to the generator to determine the amount of power that will be needed to operate the equipment.

For lighting, the wattage of the light bulb indicates the power needed. Appliances and equipment usually have labels indicating power requirements on them. Choose a generator that produces more power than will be drawn by the combination of lighting, appliances, and equipment you plan to connect to the generator including the initial surge when it is turned on. If your generator does not produce adequate power for all your needs, plan to stagger the operating times for various equipment.

If you can not determine the amount of power that will be needed, ask an electrician to determine that for you. (If your equipment draws more power than the generator can produce, then you may blow a fuse on the generator or damage the connected equipment.)

### **Using a Generator**

The primary hazards to avoid when using a generator are carbon monoxide (CO) poisoning from the toxic engine exhaust, electric shock or electrocution, and fire. Follow the directions supplied with the generator. Every year, people die in incidents related to portable generator use.

**Under no circumstances should portable generators be used indoors**, including inside a garage, carport, basement, crawlspace, or other enclosed or partially-enclosed

area, even with ventilation. Opening doors and windows or using fans will not prevent CO buildup in the home. The CO from generators can rapidly lead to full incapacitation and death, but CO can't be seen or smelled. Even if you cannot smell exhaust fumes, you may still be exposed to CO. If you start to feel sick, dizzy, or weak while using a generator, get to fresh air RIGHT AWAY - DO NOT DELAY.

Because you may have windows open to get fresh air while the power is out, be sure to place the generator away from windows, doors, and vents that could allow CO to come indoors. To avoid electrocution, keep the generator dry and do not use in rain or wet conditions. To protect the generator from moisture, operate it on a dry surface under an open canopy-like structure, such as under a tarp held up on poles. Dry your hands if wet before touching the generator.

It is a good idea to install battery-operated CO alarms or plug-in CO alarms with battery back-up in your home, according to the manufacturer's installation instructions. If CO gas from the generator enters your home and poses a health risk, the alarm will sound to warn you. Test the battery frequently and replace when needed.

**Be sure to turn the generator off and let it cool down before refueling.** Gasoline spilled on hot engine parts could ignite.

Store fuel for the generator in an approved safety can. Use the type of fuel recommended in the instructions or on the label on the generator. Local laws may restrict the amount of fuel you may store, or the storage location. Ask your local fire department for additional information about local regulations. Store the fuel outside of living areas in a locked shed or other protected area. Do not store it near a fuel-burning appliance, such as a natural gas water heater in a garage. If the fuel is spilled or the container is not sealed properly, invisible vapors from the fuel can travel along the ground and can be ignited by the appliance's pilot light or by arcs from electric switches in the appliance.

**Plug appliances directly into the generator. Or, use a heavy duty, outdoor-rated extension cord** that is rated (in watts or amps) at least equal to the sum of the connected appliance loads. Check that the entire cord is free of cuts or tears and that the plug has all three prongs, especially a grounding pin. Never try to power the house wiring by plugging the generator into a wall outlet, a practice known as "backfeeding." This is an extremely dangerous practice that presents an electrocution risk to utility workers and neighbors served by the same utility transformer. It also bypasses some of the built-in household protection devices.

### **Future Considerations**

The only recommended method to connect a generator to house wiring is by having a qualified electrician install a power transfer switch. This switch must be installed in accordance with the National Electrical Code® (NEC), which is published by the National Fire Protection Association, and all applicable state and local electrical codes. Call a qualified electrician or check with your utility company to see if they can install the appropriate equipment.

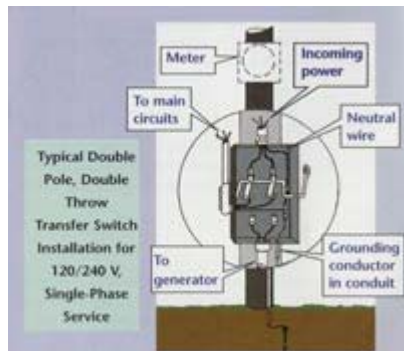
For power outages, permanently installed stationary generators are better suited for providing backup power to the home. Even a properly connected portable generator can become overloaded. This may result in overheating or stressing the generator components, possibly leading to a generator failure. Be sure to read instructions that

come with the generator to make sure you operate it within its limitations for power output.

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This information was developed by the American Red Cross with technical advice from the National Fire Protection Association (publisher of the National Electric Code®) and the U.S. Consumer Product Safety Commission.

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You can use a portable generator to supply electricity to your appliances if an emergency exists during a power outage. But if used improperly they can kill you and the people who are restoring power to your building. They also can damage the appliances you connect.

Generator sizes vary. Common units can be from 8 to 14 horsepower and capable of handling from 4,000 to 8,400 watts (including starting surge requirements). Prices may range from \$800 to \$3,000.

Connecting a generator to the main electrical supply for your house requires the services of a qualified, licensed electrician. Installing the connection and switch can cost \$600 to \$1,000.

Before connecting the generator to your household circuits, notify Blue Ridge Electric.

**WARNING:** If you connect a portable electric generator to the main electrical supply coming into the house, the electrical generator could feed back into Blue Ridge Electric's system and electrocute workers who are repairing the electrical lines.

To avoid back-feeding of electricity into utility systems, you must have a qualified, licensed electrician install a double-pole, double-throw transfer switch (see illustration above) between the generator and utility power in compliance with all state and local electrical codes. (A minimum of 10-gauge wiring must be used.)

Your generator might not be large enough to handle the load of all the lights, appliances, TV, etc. at one time. To prevent dangerous overloading, calculate wattage requirements correctly.

Consumers who have purchased portable generators to provide electricity in the event of a power outage during a storm or other disaster must use safety precautions. Portable generators can be hazardous if used improperly. The hazards are: (1) **carbon monoxide (CO) poisoning** from the toxic engine exhaust and (2) **electrocution** from connecting the generator to the home electrical wiring system.

**To avoid carbon monoxide (CO) poisoning:**



- Never use a generator indoors or in attached garages.
- Only operate the generator outdoors in a well-ventilated, dry area, away from air intakes to the home, and protected from direct exposure to rain and snow, preferably under a canopy, open shed, or carport.

**To avoid electrocution:**

- Plug individual appliances into the generator using heavy duty, outdoor rated cords with a wire gauge adequate for the appliance load.
- Observe the generator manufacturer's instructions for safe operation.
- Do not plug the generator into a wall outlet.
- If connecting the generator into the house wiring is necessary, have a qualified electrician hook up the standby electrical system, or have the local utility install a linking device if available.

**Never store gasoline in the home.** Gasoline, kerosene and other flammable liquids should be stored outside of living areas in properly labeled, non-glass safety containers. They should also not be stored in a garage if a fuel-burning appliance is in the garage. The vapor from gasoline can travel invisibly along the ground and be ignited by pilot lights or arcs caused by activating electric switches.

If at all possible, avoid connecting the electrical output of the generator into the house wiring. Instead, connect individual appliances that have their own outdoor rated power cord directly to the receptacle outlet of the generator, or connect these cord-connected appliances to the generator's electrical outlet via a suitable, outdoor-rated extension cord having a sufficient wire gauge to handle the electrical load.

If connecting into the house wiring is necessary on a temporary basis to operate permanently wired equipment, such as a water pump, furnace blower/controls, room lighting, etc., there are important steps that require the utmost care to avoid electrocution. In some locations, the local utility company may offer to install a device at the electric meter socket to permit their customers to connect a portable generator to the household wiring during periods of power outages. If that service is not available or chosen, another method is to have a qualified electrician install a manual transfer switch.

A transfer switch permits transfer of the load from the household power source that is normally supplied by the electric utility over to the portable generator. The transfer switch should be certified by UL or other independent test lab for this application, and be mounted within an electrical box. Transfer switches and related accessories designed for connecting a standby system are available from electrical supply stores. These accessories equipment includes:

1. cord sets with special locking and recessed connectors,
2. electrical boxes with controls for the branch circuits that will receive temporary power from the generator, and
3. feeder cable to connect the existing electrical panel to the transfer switch.

When properly installed, the transfer switch will isolate the circuits supplied by the generator from those normally supplied by the utility. This prevents inadvertently energizing circuits in both systems, and reduces the possibility of electrocution resulting from contact with conductors presumed to be de-energized.

Do not operate more appliances and equipment than the output rating of the generator.